

1     CLAIMS:

- 2           1.     A capacitor fabrication method comprising:
- 3                 forming a first capacitor electrode over a substrate;
- 4                 atomic layer depositing a conductive barrier layer to oxygen
- 5                 diffusion over the first electrode;
- 6                 forming a capacitor dielectric layer over the first electrode; and
- 7                 forming a second capacitor electrode over the dielectric layer.
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- 9           2.     The method of claim 1 wherein the atomic layer depositing
- 10           occurs at a temperature of from about 100 to about 600 °C and at a
- 11           pressure of from about 0.1 to about 10 Torr.
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- 13           3.     The method of claim 1 wherein the atomic layer deposited
- 14           barrier layer has a thickness of from about 50 to about 500 Angstroms.
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- 16           4.     The method of claim 1 wherein the atomic layer deposited
- 17           barrier layer contacts one of the first or second electrodes.
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- 19           5.     The method of claim 1 wherein the atomic layer deposited
- 20           barrier layer comprises WN, WSiN, TaN, TiN, TiSiN, Pt, Pt alloys, Ir,
- 21           Ir alloys, Pd, Pd alloys, RuO<sub>x</sub>, or IrO<sub>x</sub>.
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1           6.     The method of claim 1 wherein the dielectric layer exhibits  
2     a K factor of greater than about 7 at 20 °C.

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4           7.     The method of claim 1 wherein at least one of the first or  
5     second electrodes comprise polysilicon and the dielectric layer comprises  
6     oxygen.

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8           8.     The method of claim 1 wherein the dielectric layer comprises  
9     Ta<sub>2</sub>O<sub>5</sub>, ZrO<sub>2</sub>, WO<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>, HfO<sub>2</sub>, barium strontium titanate, or strontium  
10    titanate.

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12          9.     The method of claim 1 wherein the dielectric layer is over  
13    the barrier layer.

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15          10.    The method of claim 9 further comprising atomic layer  
16    depositing another conductive barrier layer to oxygen diffusion over the  
17    dielectric layer.

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19          11.    The method of claim 1 wherein the forming the electrodes  
20    and the dielectric layer occur by other than atomic layer deposition.

1           12. The method of claim 1 further comprising cleaning the first  
2 electrode prior to the atomic layer depositing by a method comprising  
3 HF dip, HF vapor clean, or  $\text{NF}_3$  remote plasma.  
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1           13. A capacitor fabrication method comprising:  
2           forming a first capacitor electrode over a substrate;  
3           chemisorbing a layer of a first precursor at least one monolayer  
4           thick over the first electrode;  
5           chemisorbing a layer of a second precursor at least one monolayer  
6           thick on the first precursor layer, a chemisorption product of the first  
7           and second precursor layers being comprised by a layer of a conductive  
8           barrier material;  
9           forming a capacitor dielectric layer over the first electrode; and  
10          forming a second capacitor electrode over the dielectric layer.

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12          14. The method of claim 13 wherein the first and second  
13          precursor layers each consist essentially of a monolayer.

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15          15. The method of claim 13 wherein the first and second  
16          precursor layers each comprise substantially saturated monolayers.

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18          16. The method of claim 13 wherein the first and second  
19          precursor each consist essentially of only one chemical species.

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21          17. The method of claim 13 wherein the first precursor is  
22          different from the second precursor.

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1           18. The method of claim 13 wherein the first and second  
2 precursors respectively comprise only one of the following pairs:  
3  $\text{WF}_6/\text{NH}_3$ ,  $\text{TaCl}_5/\text{NH}_3$ ,  $\text{TiCl}_4/\text{NH}_3$ , tetrakis(dimethylamido)titanium/ $\text{NH}_3$ ,  
4 ruthenium cyclopentadiene/ $\text{H}_2\text{O}$ ,  $\text{IrF}_5/\text{H}_2\text{O}$ , organometallic  $\text{Pt}/\text{H}_2\text{O}$ .

6           19. The method of claim 13 wherein the dielectric layer is over  
7 the barrier layer, further comprising chemisorbing additional alternating  
8 first and second precursor layers before forming the dielectric layer.

10           20. The method of claim 19 wherein the barrier layer has a  
11 thickness and a density effective to reduce oxidation of the first  
12 electrode by oxygen from over the barrier layer.

14           21. The method of claim 19 wherein the barrier layer has a  
15 thickness of from about 50 to about 500 Angstroms.

17           22. The method of claim 13 wherein the barrier layer comprises  
18  $\text{WN}$ ,  $\text{WSiN}$ ,  $\text{TaN}$ ,  $\text{TiN}$ ,  $\text{TiSiN}$ ,  $\text{Pt}$ ,  $\text{Pt}$  alloys,  $\text{Ir}$ ,  $\text{Ir}$  alloys,  $\text{Pd}$ ,  $\text{Pd}$  alloys,  
19  $\text{RuO}_x$ , or  $\text{IrO}_x$ .

21           23. The method of claim 13 wherein the dielectric layer exhibits  
22 a K factor of greater than about 7 at 20 °C.

1           24. The method of claim 13 wherein at least one of the first or  
2 second electrodes comprises polysilicon and the dielectric layer comprises  
3 oxygen.

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5           25. The method of claim 13 wherein the dielectric layer  
6 comprises  $\text{Ta}_2\text{O}_5$ ,  $\text{ZrO}_2$ ,  $\text{WO}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{HfO}_2$ , barium strontium titanate, or  
7 strontium titanate.

1           26. A capacitor construction comprising a first capacitor electrode  
2 over a substrate, a capacitor dielectric layer over the first electrode, a  
3 second capacitor electrode over the dielectric layer, and an atomic layer  
4 deposited conductive barrier layer to oxygen diffusion between the first  
5 and second electrodes.

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7           27. The construction of claim 26 wherein the dielectric layer is  
8 over the barrier layer.

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10          28. The construction of claim 27 further comprising another  
11 conductive barrier layer to oxygen diffusion over the dielectric layer.

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13          29. The construction of claim 26 wherein the barrier layer  
14 comprises WN, WSiN, TaN, TiN, TiSiN, Pt, Pt alloys, Ir, Ir alloys, Pd,  
15 Pd alloys, RuO<sub>x</sub>, or IrO<sub>x</sub>.

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17          30. The construction of claim 26 wherein the dielectric layer  
18 exhibits a K factor of greater than about 7 at 20 °C.

1           31. A capacitor construction comprising:  
2           a first capacitor electrode over a substrate;  
3           a conductive barrier layer to oxygen diffusion over the first  
4           electrode, the barrier layer comprising a chemisorption product of first  
5           and second precursor layers;  
6           a capacitor dielectric layer over the first electrode; and  
7           a second capacitor electrode over the dielectric layer.

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9           32. The construction of claim 31 wherein the barrier layer  
10          comprises WN, WSiN, TaN, TiN, TiSiN, Pt, Pt alloys, Ir, Ir alloys, Pd,  
11          Pd alloys, RuO<sub>x</sub>, or IrO<sub>x</sub>.

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13          33. The construction of claim 31 wherein the dielectric layer  
14          exhibits a K factor of greater than about 7 at 20 °C.